CHAPTER

1

Introduction to Vectors

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DPP 1.1

Vectors; Definition, Geometry Related to Vectors

Single Correct Answer Type

1. A line makes an angle θ both with x- and y-axes. A possible range of θ is

   (a) $\left[0, \frac{\pi}{4}\right]$ (b) $\left[0, \frac{\pi}{2}\right]$

   (c) $\left[\frac{\pi}{4}, \frac{\pi}{2}\right]$ (d) $\left[\frac{\pi}{6}, \frac{\pi}{3}\right]$

2. A line segment has length 63 and direction ratios are 3, –2 and 6. The components of line vector are

   (a) –27, 18, 54 (b) 27, –18, 54

   (c) 27, –18, –54 (d) –27, –18, –54

3. If $\vec{a}, \vec{b}$, and $\vec{c}$ are position vectors of A, B, and C respectively of ΔABC and if $|\vec{a} - \vec{b}| = 4$, $|\vec{b} - \vec{c}| = 2$, $|\vec{c} - \vec{a}| = 3$, then the distance between the centroid and incentre of ΔABC is

   (a) 1 (b) $\frac{1}{2}$ (c) $\frac{1}{3}$ (d) $\frac{2}{3}$

4. Let O be an interior point of ΔABC such that $\overrightarrow{OA} + 2\overrightarrow{OB} + 3\overrightarrow{OC} = \vec{0}$, then the ratio of ΔABC to area of ΔAOC is

   (a) 2 (b) $\frac{3}{2}$ (c) 3 (d) $\frac{5}{2}$

5. In a three-dimensional coordinate system, P, Q and R are images of a point $A(a, b, c)$ in the x-y the y-z and the z-x planes respectively. If G is the centroid of triangle PQR, then area of triangle AOG is (O is the origin)

   (a) 0 (b) $a^2 + b^2 + c^2$

   (c) $\frac{2}{3}(a^2 + b^2 + c^2)$ (d) none of these

6. $ABCDEF$ is a regular hexagon in the xy-plane with vertices in the anticlockwise direction. If $\overrightarrow{AB} = 2\hat{i}$, then $\overrightarrow{CD}$ is

(a) $\hat{i}+\sqrt{3}\hat{j}$ (b) $\hat{i}-\sqrt{3}\hat{j}$

(c) $-\hat{i}+\sqrt{3}\hat{j}$ (d) $\sqrt{3}\hat{i}-\hat{j}$

7. Let position vectors of points A, B and C of triangle ABC respectively be $\hat{i}+\hat{j}+2\hat{k}$, $\hat{i}+2\hat{j}+\hat{k}$ and $2\hat{i}+\hat{j}+\hat{k}$. Let l_1, l_2, and l_3 be the lengths of perpendiculars drawn from the orthocenter 'O' on the sides AB, BC and CA, then $(l_1+l_2+l_3)$ equals

(a) $\frac{2}{\sqrt{6}}$ (b) $\frac{3}{\sqrt{6}}$ (c) $\frac{\sqrt{6}}{2}$ (d) $\frac{\sqrt{6}}{3}$

8. If D, E and F are the mid-points of the sides BC, CA and AB respectively of a triangle ABC and λ is scalar, such that $\overrightarrow{AD}+\frac{2}{3}\overrightarrow{BE}+\frac{1}{3}\overrightarrow{CF}=\lambda\overrightarrow{AC}$, then λ is equal to

(a) 1/2 (b) 1 (c) 3/2 (d) 2

9. If points (1, 2, 3), (0, –4, 3), (2, 3, 5) and (1, –5, –3) are vertices of tetrahedron, then the point where lines joining the mid-points of opposite edges are concurrent is

(a) (1, –1, 2) (b) (–1, 1, 2)

(c) (1, 1, –2) (d) (–1, 1, –2)

10. The unit vector parallel to the resultant of the vectors $2\hat{i}+3\hat{j}-\hat{k}$ and $4\hat{i}-3\hat{j}+2\hat{k}$ is

(a) $\frac{1}{\sqrt{37}}(6\hat{i}+\hat{k})$ (b) $\frac{1}{\sqrt{37}}(6\hat{i}+\hat{j})$

(c) $\frac{1}{\sqrt{37}}(6\hat{j}+\hat{k})$ (d) none of these

11. In a regular hexagon $ABCDEF$, $\overrightarrow{AB}+\overrightarrow{AC}+\overrightarrow{AD}+\overrightarrow{AE}+\overrightarrow{AF}=k\overrightarrow{AD}$, where k is equal to

(a) 1 (b) 2

(c) 3 (d) none of these

12. If $\vec{a}+\vec{b}+\vec{c}=\vec{0}$ and $|\vec{a}|=3$, $|\vec{b}|=5$, $|\vec{c}|=7$, then the angle between $\vec{a}$ and $\vec{b}$ is

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{3}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$

13. If the sum of two unit vectors is a unit vector, then the magnitude of their difference is

(a) $\sqrt{2}$ (b) $\sqrt{3}$

(c) 1 (d) none of these

14. The position vectors of the points A, B, and C are $\hat{i}+2\hat{j}-\hat{k}$, $\hat{i}+\hat{j}+\hat{k}$, and $2\hat{i}+3\hat{j}+2\hat{k}$ respectively. If A is chosen as the origin, then the position vectors of B and C are

(a) $\hat{i}+2\hat{k}, \hat{i}+\hat{j}+3\hat{k}$

(b) $\hat{j}+2\hat{k}, \hat{i}+\hat{j}+3\hat{k}$

(c) $-\hat{j}+2\hat{k}, \hat{i}-\hat{j}+3\hat{k}$

(d) $-\hat{j}+2\hat{k}, \hat{i}+\hat{j}+3\hat{k}$

15. Orthocentre of an equilateral triangle ABC is the origin O. If $\overrightarrow{OA}=\vec{a}$, $\overrightarrow{OB}=\vec{b}$, $\overrightarrow{OC}=\vec{c}$, then $\overrightarrow{AB}+2\overrightarrow{BC}+3\overrightarrow{CA}=$

(a) $3\vec{c}$ (b) $3\vec{a}$ (c) $\vec{0}$ (d) $3\vec{b}$

16. If the position vectors of P and Q are $\hat{i}+2\hat{j}-7\hat{k}$ and $5\hat{i}-3\hat{j}+4\hat{k}$ respectively, the cosine of the angle between $\overrightarrow{PQ}$ and z–axis is

(a) $\frac{4}{\sqrt{162}}$ (b) $\frac{11}{\sqrt{162}}$

(c) $\frac{5}{\sqrt{162}}$ (d) $\frac{-5}{\sqrt{162}}$

17. The non-zero vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ are related by $\vec{a}=8\vec{b}$ and $\vec{c}=-7\vec{b}$ angle between $\vec{a}$ and $\vec{c}$ is

(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$ (c) π (d) 0

18. The unit vector bisecting $\overrightarrow{OY}$ and $\overrightarrow{OZ}$ is

(a) $\frac{\hat{i}+\hat{j}+\hat{k}}{\sqrt{3}}$ (b) $\frac{\hat{j}-\hat{k}}{\sqrt{2}}$

(c) $\frac{\hat{j}+\hat{k}}{\sqrt{2}}$ (d) $\frac{-\hat{j}+\hat{k}}{\sqrt{2}}$

19. A unit tangent vector at $t=2$ on the curve $x=t^2+2$, $y=4t-5$ and $z=2t^2-6t$ is

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(a) $\frac{1}{\sqrt{3}}(\hat{i}+\hat{j}+\hat{k})$ (b) $\frac{1}{3}(2\hat{i}+2\hat{j}+\hat{k})$

(c) $\frac{1}{\sqrt{6}}(2\hat{i}+\hat{j}+\hat{k})$ (d) $\frac{1}{3}(\hat{i}+\hat{j}+\hat{k})$

20. If $\vec{a}$ and $\vec{b}$ are position vectors of A and B respectively, then the position vector of a point C in $\overrightarrow{AB}$ produced such that $\overrightarrow{AC} = 2015\,\overrightarrow{AB}$ is

(a) $2014\vec{a} - 2015\vec{b}$

(b) $2014\vec{b} + 2015\vec{a}$

(c) $2015\vec{b} + 2014\vec{a}$

(d) $2015\vec{b} - 2014\vec{a}$

21. Let $\vec{a} = (1, 1, -1)$, $\vec{b} = (5, -3, -3)$ and $\vec{c} = (3, -1, 2)$. If $\vec{r}$ is collinear with $\vec{c}$ and has length $\frac{|\vec{a}+\vec{b}|}{2}$, then $\vec{r}$ equals

(a) $\pm 3\vec{c}$ (b) $\pm\frac{3}{2}\vec{c}$ (c) $\pm\vec{c}$ (d) $\pm\frac{2}{3}\vec{c}$

22. A line passes through the points whose position vectors are $\hat{i}+\hat{j}-2\hat{k}$ and $\hat{i}-3\hat{j}+\hat{k}$. The position vector of a point on it at unit distance from the first point is

(a) $\frac{1}{5}(5\hat{i}+\hat{j}-7\hat{k})$ (b) $\frac{1}{5}(4\hat{i}+9\hat{j}-15\hat{k})$

(c) $(\hat{i}-4\hat{j}+3\hat{k})$ (d) $\frac{1}{5}(\hat{i}-4\hat{j}+3\hat{k})$

Comprehension Type

For Q. 23 to 25

Three point A, B, and C have position vectors $-2\vec{a}+3\vec{b}+5\vec{c}$, $\vec{a}+2\vec{b}+3\vec{c}$ and $7\vec{a}-\vec{c}$ with reference to an origin O. Answer the following questions?

23. Which of the following is true?

(a) $\overrightarrow{AC} = 2\overrightarrow{AB}$ (b) $\overrightarrow{AC} = -3\overrightarrow{AB}$

(c) $\overrightarrow{AC} = 3\overrightarrow{AB}$ (d) None of these

24. Which of following is true?

(a) $2\overrightarrow{OA} - 3\overrightarrow{OB} + \overrightarrow{OC} = \vec{0}$

(b) $2\overrightarrow{OA} + 7\overrightarrow{OB} + 9\overrightarrow{OC} = \vec{0}$

(c) $\overrightarrow{OA} + \overrightarrow{OB} + \overrightarrow{OC} = \vec{0}$

(d) None of these

25. B divided AC in ratio

(a) 2 : 1 (b) 2 : 3

(c) 2 : –3 (d) 1 : 2

Answers Key

Single Correct Answer Type

1. (c)	**2.** (b)	**3.** (c)	**4.** (c)
5. (a)	**6.** (c)	**7.** (c)	**8.** (a)
9. (a)	**10.** (a)	**11.** (c)	**12.** (b)
13. (b)	**14.** (d)	**15.** (b)	**16.** (b)
17. (c)	**18.** (c)	**19.** (b)	**20.** (d)
21. (c)	**22.** (a)		

Comprehension Type

23. (c) **24.** (a) **25.** (d)

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DPP 1.2

Linear Combination of Vectors, Dependent and Independent Vectors

Single Correct Answer Type

1. The number of integral values of p for which $(p+1)\hat{i}-3\hat{j}+p\hat{k}$, $p\hat{i}+(p+1)\hat{j}-3\hat{k}$ and $-3\hat{i}+p\hat{j}+(p+1)\hat{k}$ are linearly dependent vectors is

(a) 0 (b) 1 (c) 2 (d) 3

2. The base vectors $\vec{a}_1, \vec{a}_2$ and $\vec{a}_3$ are given in terms of base vectors $\vec{b}_1, \vec{b}_2$ and $\vec{b}_3$ as $\vec{a}_1 = 2\vec{b}_1 + 3\vec{b}_2 - \vec{b}_3$; $\vec{a}_2 = \vec{b}_1 - 2\vec{b}_2 + 2\vec{b}_3$ and $\vec{a}_3 = -2\vec{b}_1 + \vec{b}_2 - 2\vec{b}_3$. If $\vec{F} = 3\vec{b}_1 - \vec{b}_2 + 2\vec{b}_3$, then vector $\vec{F}$ in terms of $\vec{a}_1, \vec{a}_2$ and $\vec{a}_3$ is

(a) $\vec{F} = 3\vec{a}_1 + 2\vec{a}_2 + 5\vec{a}_3$

(b) $\vec{F} = 3\vec{a}_1 - 5\vec{a}_2 - 2\vec{a}_3$

(c) $\vec{F} = 2\vec{a}_1 + 5\vec{a}_2 + 3\vec{a}_3$

(d) none of these

3. The number of distinct real values of λ for which the vectors $\lambda^3\hat{i}+\hat{k}$, $\hat{i}-\lambda^3\hat{j}$ and $\hat{i}+(2\lambda-\sin\lambda)\hat{j}-\lambda\hat{k}$ are coplanar is

(a) 0 (b) 1 (c) 2 (d) 3

4. The points $A(2-x, 2, 2)$, $B(2, 2-y, 2)$, $C(2, 2, 2-z)$ and $D(1, 1, 1)$ are coplanar, then locus of $P(x, y, z)$ is

(a) $\frac{1}{x}+\frac{1}{y}+\frac{1}{z}=1$

(b) $x+y+z=1$

(c) $\frac{1}{1-x}+\frac{1}{1-y}+\frac{1}{1-z}=1$

(d) None of these

5. If a_1 and a_2 are two values of a for which the unit vector $a\hat{i}+b\hat{j}+\frac{1}{2}\hat{k}$ is linearly dependent with $\hat{i}+2\hat{j}$ and $\hat{j}-2\hat{k}$, then $\frac{1}{a_1}+\frac{1}{a_2}$ is equal to

(a) 1 (b) $\frac{1}{8}$ (c) $\frac{-16}{11}$ (d) $\frac{-11}{16}$

6. Let a, b, and c be distinct non-negative numbers and the vectors $a\hat{i}+a\hat{j}+c\hat{k}$, $\hat{i}+\hat{k}$, $c\hat{i}+c\hat{j}+b\hat{k}$ lie in a plane, then the quadratic equation $ax^2+2cx+b=0$ has

(a) real and equal roots
(b) real unequal roots
(c) unreal roots
(d) both roots real and positive

7. In the ΔOAB, M is the mid-point of AB, C is a point on OM, such that $2\overrightarrow{OC}=\overrightarrow{CM}$. X is a point on the side OB such that $\overrightarrow{OX}=2\overrightarrow{XB}$. The line XC is produced to meet OA in Y. Then $\frac{OY}{YA}=$

(a) $\frac{1}{3}$ (b) $\frac{2}{7}$ (c) $\frac{3}{2}$ (d) $\frac{2}{5}$

8. Points X and Y are taken on the sides QR and RS, respectively of a parallelogram $PQRS$, so that $\overrightarrow{QX}=4\overrightarrow{XR}$ and $\overrightarrow{RY}=4\overrightarrow{YS}$. The line XY cuts the line PR at Z. Then $\overrightarrow{PZ}$ is

(a) $\frac{21}{25}\overrightarrow{PR}$ (b) $\frac{16}{25}\overrightarrow{PR}$

(c) $\frac{17}{25}\overrightarrow{PR}$ (d) None of these

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9. On the xy plane where O is the origin, given points, $A(1, 0)$, $B(0, 1)$ and $C(1, 1)$. Let P, Q, and R be moving points on the line OA, OB, OC respectively such that $\overrightarrow{OP} = 45t(\overrightarrow{OA})$, $\overrightarrow{OQ} = 60t(\overrightarrow{OB})$, $\overrightarrow{OR} = (1-t)(\overrightarrow{OC})$ with $t > 0$. If the three points P, Q and R are collinear then the value of t is equal to

(a) $\frac{1}{106}$ (b) $\frac{7}{187}$

(c) $\frac{1}{100}$ (d) none of theses

Multiple Correct Answers Type

10. Given three vectors $\vec{a}, \vec{b}$, and $\vec{c}$ are non-zero and non-coplanar vectors. Then which of the following are coplanar.

(a) $\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}$

(b) $\vec{a}-\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}$

(c) $\vec{a}+\vec{b}, \vec{b}-\vec{c}, \vec{c}+\vec{a}$

(d) $\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}-\vec{a}$

Answers Key

Single Correct Answer Type

1. (b) **2.** (c) **3.** (a) **4.** (a)
5. (c) **6.** (a) **7.** (b) **8.** (a)
9. (b)

Multiple Correct Answers Type

10. (b, c, d)

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CHAPTER

2

Different Products of Vectors and Their Geometrical Applications

DPP 2.1

Dot Product

Single Correct Answer Type

1. Let $a, b > 0$ and $\vec{\alpha} = \frac{\hat{i}}{a} + \frac{4\hat{j}}{b} + b\hat{k}$ and $\vec{\beta} = b\hat{i} + a\hat{j} + \frac{1}{b}\hat{k}$, then the maximum value of $\frac{10}{5 + \vec{\alpha} \cdot \vec{\beta}}$ is

(a) 1 (b) 2 (c) 4 (d) 8

2. If a vector $\vec{r}$ is equally inclined with the vectors $\vec{a} = \cos\theta\hat{i} + \sin\theta\hat{j}$, $\vec{b} = -\sin\theta\hat{i} + \cos\theta\hat{j}$ and $\vec{c} = \hat{k}$, then the angle between $\vec{r}$ and $\vec{a}$ is

(a) $\cos^{-1}\left(\frac{1}{\sqrt{2}}\right)$ (b) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$

(c) $\cos^{-1}\left(\frac{1}{3}\right)$ (d) $\cos^{-1}\left(\frac{1}{2}\right)$

3. Let G be the centroid of the ΔABC whose sides are of lengths a, b, c. If P be a point in the plane of ΔABC such that $PA = 1$, $PB = 3$, $PC = 4$ and $PG = 2$, then the value of $a^2 + b^2 + c^2$ is

(a) 42 (b) 40 (c) 36 (d) 28

4. If $\vec{a} = 3\hat{i} - \hat{j} + 5\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - 3\hat{k}$ are given vectors. A vector $\vec{c}$ which is perpendicular to z-axis satisfying $\vec{c} \cdot \vec{a} = 9$ and $\vec{c} \cdot \vec{b} = -4$. If inclination of $\vec{c}$ with x-axis and y-axis is α and β respectively, then which of the following is not true?

(a) $\alpha > \frac{\pi}{4}$ (b) $\beta > \frac{\pi}{2}$

(c) $\alpha > \frac{\pi}{2}$ (d) $\beta < \frac{\pi}{2}$

5. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a}$ is perpendicular to the plane of $\vec{b}, \vec{c}$ and the angle between $\vec{b}, \vec{c}$ is $\frac{\pi}{3}$, then $|\vec{a} + \vec{b} + \vec{c}| =$

(a) 1 (b) 2 (c) 3 (d) 4

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6. A unit vector $\vec{a}$ in the plane of $\vec{b} = 2\hat{i} + \hat{j}$ and $\vec{c} = \hat{i} - \hat{j} + \hat{k}$ is such that angle between $\vec{a}$ and $\vec{b}$ is same as angle between $\vec{a}$ and $\vec{d}$ where $\vec{d} = \hat{j} + 2\hat{k}$ is

(a) $\frac{\hat{i}+\hat{j}+\hat{k}}{\sqrt{3}}$ (b) $\frac{\hat{i}-\hat{j}+\hat{k}}{\sqrt{3}}$

(c) $\frac{2\hat{i}+\hat{j}}{\sqrt{5}}$ (d) $\frac{2\hat{i}-\hat{j}}{\sqrt{5}}$

7. In a tetrahedron $OABC$, the edges are of lengths, $|OA| = |BC| = a$, $|OB| = |AC| = b$, $|OC| = |AB| = c$. Let G_1 and G_2 be the centroids of the triangle ABC and AOC such that $OG_1 \perp BG_2$, then the value of $\frac{a^2+c^2}{b^2}$ is

(a) 2 (b) 3 (c) 6 (d) 9

8. The vectors $\vec{x}$ and $\vec{y}$ satisfy the equation $p\vec{x} + q\vec{y} = \vec{a}$ (where p, q are scalar constants and $\vec{a}$ is a known vector). It is given that $\vec{x} \cdot \vec{y} \geq \frac{|\vec{a}|^2}{4pq}$, then $\frac{|\vec{x}|}{|\vec{y}|}$ is equal to $(pq > 0)$

(a) 1 (b) $\frac{p^2}{q^2}$ (c) $\frac{p}{q}$ (d) $\frac{q}{p}$

9. If $\vec{a}, \vec{b}, \vec{c}$ non-zero vectors such that $\vec{a}$ is perpendicular to $\vec{b}$ and $\vec{c}$ and $|\vec{a}| = 1, |\vec{b}| = 2, |\vec{c}| = 1, \vec{b} \cdot \vec{c} = 1$. There is a non-zero vector coplanar with $\vec{a} + \vec{b}$ and $2\vec{b} - \vec{c}$ and $\vec{d} \cdot \vec{a} = 1$, then the minimum value of $|\vec{d}|$ is

(a) $\frac{2}{\sqrt{13}}$ (b) $\frac{3}{\sqrt{13}}$ (c) $\frac{4}{\sqrt{5}}$ (d) $\frac{4}{\sqrt{13}}$

10. Let two non-collinear vectors $\vec{a}$ and $\vec{b}$ inclined at an angle $\frac{2\pi}{3}$ be such that $|\vec{a}| = 3$ and $|\vec{b}| = 2$. If a point P moves so that at any time t its position vector $\overrightarrow{OP}$ (where O is the origin) is given as $\overrightarrow{OP} = \left(t + \frac{1}{t}\right)\vec{a} + \left(t - \frac{1}{t}\right)\vec{b}$ then least distance of P from the origin is

(a) $\sqrt{2\sqrt{133} - 10}$ (b) $\sqrt{2\sqrt{133} + 10}$

(c) $\sqrt{5 + \sqrt{133}}$ (d) none of these

11. Four vectors $\vec{a}, \vec{b}, \vec{c}$ and $\vec{x}$ satisfy the relation $(\vec{a} \cdot \vec{x})\vec{b} = \vec{c} + \vec{x}$ where $\vec{b} \cdot \vec{a} \neq 1$. The value of $\vec{x}$ in terms of $\vec{a}, \vec{b}$ and $\vec{c}$ is equal to

(a) $\frac{(\vec{a} \cdot \vec{c})\vec{b} - \vec{c}(\vec{a} \cdot \vec{b} - 1)}{(\vec{a} \cdot \vec{b} - 1)}$

(b) $\frac{\vec{c}}{\vec{a} \cdot \vec{b} - 1}$

(c) $\frac{2(\vec{a} \cdot \vec{c})\vec{b} + \vec{c}}{\vec{a} \cdot \vec{b} - 1}$

(d) $\frac{2(\vec{a} \cdot \vec{c})\vec{c} + \vec{c}}{\vec{a} \cdot \vec{b} - 1}$

12. If area of a triangular face BCD of a regular tetrahedron $ABCD$ is $4\sqrt{3}$ sq. units, then the area of a triangle whose two sides are represented by vectors $\overrightarrow{AB}$ and $\overrightarrow{CD}$ is

(a) 6 sq. units (b) 8 sq. units

(c) 12 sq. units (d) 16 sq. units

13. If $OABC$ is a tetrahedron such that $OA^2 + BC^2 = OB^2 + CA^2 = OC^2 + AB^2$, then which of the following is not true?

(a) $OA \perp BC$ (b) $OB \perp AC$

(c) $OC \perp AB$ (d) $AB \perp AC$

14. If $\vec{a}, \vec{b}$ and $\vec{c}$ are three units vectors equally inclined to each other at an angle α. Then the angle between $\vec{a}$ and plane of $\vec{b}$ and $\vec{c}$ is

(a) $\theta = \cos^{-1}\left(\frac{\cos\alpha}{\cos\frac{\alpha}{2}}\right)$

(b) $\theta = \sin^{-1}\left(\frac{\cos\alpha}{\cos\frac{\alpha}{2}}\right)$

(c) $\theta = \cos^{-1}\left(\frac{\sin\frac{\alpha}{2}}{\sin\alpha}\right)$

(d) $\theta = \sin^{-1}\left(\frac{\sin\frac{\alpha}{2}}{\sin\alpha}\right)$

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15. If a, b, c and $A, B, C \in R - \{0\}$ such that $aA + bB + cC + \sqrt{(a^2+b^2+c^2)(A^2+B^2+C^2)} = 0$, then value of $\frac{aB}{bA} + \frac{bC}{cB} + \frac{cA}{aC}$ is

(a) 3 (b) 4 (d) 5 (d) 6

Answers Key

Single Correct Answer Type

1. (a) **2.** (b) **3.** (a) **4.** (c)
5. (b) **6.** (b) **7.** (b) **8.** (d)
9. (d) **10.** (b) **11.** (a) **12.** (b)
13. (d) **14.** (a) **15.** (a)

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DPP 2.2

Cross Product

Single Correct Answer Type

1. Let $\vec{a}$ and $\vec{b}$ be two vectors of equal magnitude 5 units. Let $\vec{p}, \vec{q}$ be vectors such that $\vec{p} = \vec{a} - \vec{b}$ and $\vec{q} = \vec{a} + \vec{b}$. If $|\vec{p} \times \vec{q}| = 2\{\lambda - (\vec{a} \cdot \vec{b})^2\}^{\frac{1}{2}}$, then value of λ is

(a) 25 (b) 125
(c) 625 (d) none of these

2. Let $\vec{u} = 2\hat{i} - \hat{j} + \hat{k}, \vec{v} = -3\hat{j} + 2\hat{k}$ be vectors and $\vec{w}$ be a unit vector in the xy-plane. Then the maximum possible value of $|(\vec{u} \times \vec{v}) \cdot \vec{w}|$ is

(a) $\sqrt{5}$ (b) $\sqrt{12}$ (c) $\sqrt{13}$ (d) $\sqrt{17}$

3. Let $\vec{a}, \vec{b}$ and $\vec{c}$ are three unit vectors in a plane such that they are equally inclined to each other, then the value of $(\vec{a} \times \vec{b}) \cdot (\vec{b} \times \vec{c}) + (\vec{b} \times \vec{c}) \cdot (\vec{c} \times \vec{a}) + (\vec{c} \times \vec{a}) \cdot (\vec{a} \times \vec{b})$ can be

(a) $\frac{9}{4}$ (b) $-\frac{9}{4}$
(c) $\frac{3}{4}$ (d) $-\frac{3}{4}$

4. The coordinates of the mid-points of the sides of ΔPQR are $(3a, 0, 0)$, $(0, 3b, 0)$ and $(0, 0, 3c)$ respectively, then the area of ΔPQR is

(a) $18\sqrt{b^2c^2 + c^2a^2 + a^2b^2}$
(b) $9\sqrt{b^2c^2 + c^2a^2 + a^2b^2}$
(c) $\frac{9}{2}\sqrt{b^2c^2 + c^2a^2 + a^2b^2}$
(d) $18\sqrt{ab + bc + ca}$

5. If $\vec{a} = \hat{i} + \hat{j} + \hat{k}, \vec{a} \cdot \vec{b} = 1$ and $\vec{a} \times \vec{b} = \hat{j} - \hat{k},$, then $\vec{b} \cdot (3\hat{i} + 4\hat{j} + 5\hat{k}) =$

(a) 3 (b) 9 (c) 10 (d) 12

6. If $\vec{a}, \vec{b}, \vec{c}$ are unit vectors such that $\vec{a} \cdot \vec{b} = 0, (\vec{a} - \vec{c}) \cdot (\vec{b} + \vec{c}) = 0$ and $\vec{c} = \lambda\vec{a} + \mu\vec{b} + \omega(\vec{a} \times \vec{b})$, where λ, μ, ω are scalars, then

(a) $\mu^2 + \omega^2 = 1$
(b) $\lambda + \mu = 1$
(c) $(\mu + 1)^2 + \mu^2 + \omega^2 = 1$
(d) $\lambda^2 + \mu^2 = 1$

7. Let ΔABC be a given triangle. If $|\overrightarrow{BA} - t\overrightarrow{BC}| \geq |\overrightarrow{AC}|$ for any $t \in R$, then ΔABC is

(a) Equilateral (b) Right angled
(c) Isosceles (d) None of these

8. If $\vec{a}, \vec{b}$ are vectors perpendicular to each other and $|\vec{a}| = 2, |\vec{b}| = 3, \vec{c} \times \vec{a} = \vec{b}$, then the least value of $2|\vec{c} - \vec{a}|$ is

(a) 1 (b) 2 (c) 3 (d) 4

9. If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a}| = 1, |\vec{b}| = 4, \vec{a} \cdot \vec{b} = 2$. If $\vec{c} = (2\vec{a} \times \vec{b}) - 3\vec{b}$, then the angle between $\vec{b}$ and $\vec{c}$ is

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{6}$
(c) $\frac{3\pi}{4}$ (d) $\frac{5\pi}{6}$

10. If $\vec{a}$ and $\vec{b}$ are non-zero, non-parallel vectors, then the value of $|\vec{a} + \vec{b} + \vec{a} \times \vec{b}|^2 + |\vec{a} + \vec{b} - \vec{a} \times \vec{b}|^2$ equals

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(a) $(1+\vec{a}\cdot\vec{a})(1+\vec{b}\cdot\vec{b})$

(b) $2(1+\vec{a}\cdot\vec{a})(1+\vec{b}\cdot\vec{b})$

(c) $2\{(1+\vec{a}\cdot\vec{a})(1+\vec{b}\cdot\vec{b})-(1-\vec{a}\cdot\vec{b})^2\}$

(d) $2\{(1-\vec{a}\cdot\vec{a})(1-\vec{b}\cdot\vec{b})+(1-\vec{a}\cdot\vec{b})^2\}$

11. If $a^2+b^2+c^2=1$ where $a, b, c \in R$, then the maximum value of $(4a-3b)^2+(5b-4c)^2+(3c-5a)^2$ is

(a) 25 (b) 50

(c) 144 (d) none of these

Multiple Correct Answers Type

12. Three vectors $\vec{a},\vec{b},\vec{c}$ are such that $\vec{a}\times\vec{b}=4(\vec{a}\times\vec{c})$ and $|\vec{a}|=|\vec{b}|=1$ and $|\vec{c}|=\frac{1}{4}$. If the angle between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{3}$, then $\vec{b}$ is

(a) $\vec{a}+4\vec{c}$ (b) $\vec{a}-4\vec{c}$

(c) $4\vec{c}-\vec{a}$ (d) $2\vec{c}-\vec{a}$

13. If $2\vec{a}, 3\vec{b}, 2(\vec{a}\times\vec{b})$ are position vectors of the vertices A, B, C, of ΔABC and $|\vec{a}|=|\vec{b}|=1; \overrightarrow{OA}\cdot\overrightarrow{OB}=-3$ (where O is the origin), then

(a) Triangle ABC is right-angled triangle

(b) Angle B is 90°

(c) $A=\cos^{-1}\left(\sqrt{\frac{7}{19}}\right)$

(d) The position vector of orthocentre is $2(\vec{a}\times\vec{b})$

Answers Key

Single Correct Answer Type

1. (c) **2.** (d) **3.** (a) **4.** (a)
5. (a) **6.** (c) **7.** (b) **8.** (c)
9. (d) **10.** (c) **11.** (b)

Multiple Correct Answers Type

12. (a, c) **13.** (a, c, d)

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DPP 2.3

Scalar Triple product

Single Correct Answer Type

1. Number of integral value(s) of λ for which vectors $x^2\hat{i}-\hat{j}+x\hat{k}$, $(\lambda-1)\hat{i}-2\lambda\hat{j}+\hat{k}$ and $\hat{i}-\hat{j}+\hat{k}$, in the order form right-handed system $\forall x \in R$, is
(a) 0 (b) 2 (c) 4 (d) 6

2. Let $\vec{a},\vec{b},\vec{c}$ be three linearly independent vectors, then $\dfrac{[\vec{a}+2\vec{b}-\vec{c}\ \ 2\vec{a}+\vec{b}+c\ \ 4\vec{a}-\vec{b}+5\vec{c}]}{[\vec{a}\ \vec{b}\ \vec{c}]}$
(a) 0 (b) 1 (c) 2 (d) –1

3. If $\vec{a},\vec{b}$ are two unit vectors such that $\vec{a}+(\vec{a}\times\vec{b})=\vec{c}$, where $|\vec{c}|=2$, then value of $[\vec{a}\vec{b}\vec{c}]$ is
(a) 0 (b) ±1 (c) –3 (d) 3

4 Let $\vec{a}$ and $\vec{b}$ be unit vectors that are perpendicular to each other, then $[\vec{a}+(\vec{a}\times\vec{b})\ \vec{b}+(\vec{a}\times\vec{b})\ \vec{a}\times\vec{b}]$ is equal to
(a) 1 (b) zero (c) –1 (d) 3

5. If V is the volume of the parallelepiped having three coterminous edges as $\vec{a},\vec{b}$ and $\vec{c}$, then the volume of the parallelepiped having three coterminous edges as
$\vec{\alpha}=(\vec{a}\cdot\vec{a})\vec{a}+(\vec{a}\cdot\vec{b})\vec{b}+(\vec{a}\cdot\vec{c})\vec{c}$,
$\vec{\beta}=(\vec{b}\cdot\vec{a})\vec{a}+(\vec{b}\cdot\vec{b})\vec{b}+(\vec{b}\cdot\vec{c})\vec{c}$
and $\vec{\gamma}=(\vec{c}\cdot\vec{a})\vec{a}+(\vec{c}\cdot\vec{b})\vec{b}+(\vec{c}\cdot\vec{c})\vec{c}$ is
(a) $3V$ (b) $4V$ (c) V^2 (d) V^3

6. A parallelepiped is formed by planes drawn parallel to coordinate axes through the points $A=(1,2,3)$ and $B=(9,8,5)$. The volume of that parallelepiped is equal to (in cubic units)
(a) 192 (b) 48 (c) 32 (d) 96

7. If $\vec{a},\vec{b}$ and $\vec{c}$ are any three vectors forming a linearly independent system, then $\forall\theta\in R$
$\vec{p}=\vec{a}\cos\theta+\vec{b}\sin\theta+\vec{c}\cos 2\theta$
$\vec{q}=\vec{a}\cos\left(\frac{2\pi}{3}+\theta\right)+\vec{b}\sin\left(\frac{2\pi}{3}+\theta\right)+\vec{c}\cos 2\left(\frac{2\pi}{3}+\theta\right)$
and $\vec{r}=\vec{a}\cos\left(\theta-\frac{2\pi}{3}\right)+\vec{b}\sin\left(\theta-\frac{2\pi}{3}\right)+\vec{c}\cos 2\left(\theta-\frac{2\pi}{3}\right)$
then $[\vec{p}\ \vec{q}\ \vec{r}]=$
(a) $[\vec{a}\ \vec{b}\ \vec{c}]\cos\theta$ (b) $[\vec{a}\ \vec{b}\ \vec{c}]\cos 2\theta$
(c) $[\vec{a}\ \vec{b}\ \vec{c}]\cos 3\theta$ (d) none of these

8. Let $\vec{r}=(\vec{a}\times\vec{b})\sin x+(\vec{b}\times\vec{c})\cos y+(\vec{c}\times\vec{a})$, where $\vec{a},\vec{b}$ and $\vec{c}$ are non-zero non-coplanar vectors. If $\vec{r}$ is orthogonal to $3\vec{a}+5\vec{b}+2\vec{c}$, then the value of $\sec^2 y+\operatorname{cosec}^2 x+\sec y\operatorname{cosec} x$ is
(a) 3 (b) 4 (c) 5 (d) 6

9. In a regular tetrahedron, let θ be angle between any edge and a face not containing the edge. Then the value of $\cos^2\theta$ is
(a) 1/6 (b) 1/9
(c) 1/3 (d) None of these

10. $DABC$ be a tetrahedron such that AD is perpendicular to the base ABC and $\angle ABC = 30^\circ$. The volume of tetrahedron is 18. If value of $AB+BC+AD$ is minimum, then the length of AC is

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(a) $6\sqrt{2-\sqrt{3}}$ (b) $3(\sqrt{6}-\sqrt{2})$

(c) $6\sqrt{2+\sqrt{3}}$ (d) $3(\sqrt{6}+\sqrt{2})$

Multiple Correct Answers Type

11. If $\alpha(\vec{a}\times\vec{b})+\beta(\vec{b}\times\vec{c})+\gamma(\vec{c}\times\vec{a})=0$, then

(a) $\vec{a},\vec{b},\vec{c}$ are coplanar if all of $\alpha, \beta, \gamma \neq 0$

(b) $\vec{a},\vec{b},\vec{c}$ are coplanar if any one of $\alpha, \beta, \gamma \neq 0$

(c) $\vec{a},\vec{b},\vec{c}$ are non-coplanar for any $\alpha, \beta, \gamma \neq 0$

(d) none of these

Answers Key

Single Correct Answer Type

1. (a) **2.** (a) **3.** (d) **4.** (a)
5. (d) **6.** (d) **7.** (d) **8.** (a)
9. (c) **10.** (a)

Multiple Correct Answers Type

11. (a, b)

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DPP 2.4

Vector Triple Product, Reciprocal System of Vectors

Single Correct Answer Type

1. $\vec{a}=2\hat{i}+\hat{j}+\hat{k}$, $\vec{b}=b_1\hat{i}+b_2\hat{j}+b_3\hat{k}$, $\vec{a}\times\vec{b}=5\hat{i}+2\hat{j}-12\hat{k}$, $\vec{a}\cdot\vec{b}=11$, then $b_1+b_2+b_3=$

(a) 3 (b) 5 (c) 7 (d) 9

2. If $\vec{a},\vec{b},\vec{c},\vec{d}$ are unit vectors such that $\vec{a}\cdot\vec{b}=\frac{1}{2}$, $\vec{c}\cdot\vec{d}=\frac{1}{2}$ and angle between $\vec{a}\times\vec{b}$ and $\vec{c}\times\vec{d}$ is $\frac{\pi}{6}$ then the value of $|[\vec{a}\,\vec{b}\,\vec{d}]\vec{c}-[\vec{a}\,\vec{b}\,\vec{c}]\vec{d}|=$

(a) 3/2 (b) 3/4 (c) 3/8 (d) 2

3. If $\vec{a},\vec{b},\vec{c},\vec{d}$ be vectors such that

$$[\vec{a}\,\vec{b}\,\vec{c}]=2$$

and $(\vec{a}\times\vec{b})\times(\vec{c}\times\vec{d})+(\vec{b}\times\vec{c})\times(\vec{a}\times\vec{d})+(\vec{c}\times\vec{a})\times(\vec{b}\times\vec{d})=-\mu\vec{d}$,

then the value of μ is

(a) 0 (b) 1 (c) 3 (d) 4

4. Let $(\hat{p}\times\vec{q})\times\hat{p}+(\hat{p}\cdot\vec{q})\vec{q}=(x^2+y^2)\vec{q}+(14-4x-6y)\vec{p}$,

where $\hat{p}$ and $\vec{q}$ are two non-collinear vectors ($\hat{p}$ is a unit vector) and x, y are scalars. Then the value of $(x+y)$ is

(a) 4 (b) 5 (c) 6 (d) 7

5. If $\vec{a},\vec{b},\vec{c}$ are three non-coplanar vectors such that $\vec{a}\times\vec{b}=\vec{c},\vec{b}\times\vec{c}=\vec{a},\vec{c}\times\vec{a}=\vec{b}$, then the value of $|\vec{a}|+|\vec{b}|+|\vec{c}|$ is

(a) 1/3 (b) 1 (c) 3 (d) 6

6. Let $\hat{a}$ and $\hat{b}$ be two unit vectors such that $\hat{a}\cdot\hat{b}=\frac{1}{3}$ and $\hat{a}\times\hat{b}=\hat{c}$. Also $\vec{F}=\alpha\hat{a}+\beta\hat{b}+\gamma\hat{c}$, where α, β, γ are scalars. If $\alpha=k_1(\hat{F}\cdot\hat{a})-k_2(\hat{F}\cdot\hat{b})$ then the value of $2(k_1+k_2)$ is

(a) $2\sqrt{3}$ (b) $\sqrt{3}$ (c) 3 (d) 1

7. Let $\vec{a}$ and $\vec{c}$ be unit vectors inclined at $\pi/3$ with each other. If $(\vec{a}\times(\vec{b}\times\vec{c}))\cdot(\vec{a}\times\vec{c})=5$, then $[\vec{a}\,\vec{b}\,\vec{c}]$ is equal to

(a) –10 (b) –5

(c) –20 (d) none of these

8. If $\vec{a}=\hat{i}+\hat{j}+2\hat{k},\vec{b}=\hat{i}+2\hat{j}+2\hat{k}$ and $|\vec{c}|=1$ such that $[\vec{a}\times\vec{b}\;\vec{b}\times\vec{c}\;\vec{c}\times\vec{a}]$ has maximum value, then the value of $|(\vec{a}\times\vec{b})\times\vec{c}|^2$ is

(a) 0 (b) 1

(c) $\frac{4}{3}$ (d) none of these

9. If the angles between the vectors $\vec{a}$ and $\vec{b},\vec{b}$ and $\vec{c},\vec{c}$ and $\vec{a}$ are respectively $\frac{\pi}{6},\frac{\pi}{4}$ and $\frac{\pi}{3}$, then the angle the vector $\vec{a}$ makes with the plane containing $\vec{b}$ and $\vec{c}$, is

(a) $\cos^{-1}\sqrt{1-\sqrt{2/3}}$ (b) $\cos^{-1}\sqrt{2-\sqrt{3/2}}$

(c) $\cos^{-1}\sqrt{\sqrt{3/2}-1}$ (d) $\cos^{-1}\sqrt{\sqrt{2/3}}$

10. Let $\vec{a},\vec{b}$ and $\vec{c}$ be three vectors having magnitudes 1, 1 and 2 respectively. If $\vec{a}\times(\vec{a}\times\vec{c})-\vec{b}=0$, then the acute angle between $\vec{a}$ and $\vec{c}$ is

(a) $\pi/4$ (b) $\pi/6$ (c) $\pi/3$ (d) $\pi/2$

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11. If $\vec{a},\vec{b},\vec{c}$ are three non-coplanar vectors and $\vec{p},\vec{q},\vec{r}$ are their reciprocal vectors, then $(l\vec{a}+m\vec{b}+n\vec{c})\cdot(l\vec{p}+m\vec{q}+n\vec{r})$ is equal to

(a) $l^2+m^2+n^2$ (b) $lm+mn+nl$

(c) 0 (d) None of these

12. Let $\vec{A}=\hat{i}-3\hat{j}+4\hat{k}$, $\vec{B}=6\hat{i}+4\hat{j}-8\hat{k}$, $\vec{C}=5\hat{i}+2\hat{j}+5\hat{k}$ and a vector $\vec{R}$ satisfies $\vec{R}\times\vec{B}=\vec{C}\times\vec{B}$, $\vec{R}\cdot\vec{A}=0$, then the value of $\dfrac{|\vec{B}|}{|\vec{R}-\vec{C}|}$ is

(a) 1 (b) 2 (c) 3 (d) 4

Multiple Correct Answers Type

13. The volume of the parallelepiped whose coterminous edges are represented by the vectors $2\vec{b}\times\vec{c}, 3\vec{c}\times\vec{a}$ and $4\vec{a}\times\vec{b}$ where

$$\vec{a}=(1+\sin\theta)\hat{i}+\cos\theta\hat{j}+\sin 2\theta\hat{k},$$

$$\hat{b}=\sin\left(\theta+\frac{2\pi}{3}\right)\hat{i}+\cos\left(\theta+\frac{2\pi}{3}\right)\hat{j}+\sin\left(2\theta+\frac{4\pi}{3}\right)\hat{k},$$

$$\vec{c}=\sin\left(\theta-\frac{2\pi}{3}\right)\hat{i}+\cos\left(\theta-\frac{2\pi}{3}\right)\hat{j}+\sin\left(2\theta-\frac{4\pi}{3}\right)\hat{k}$$

is 18 cubic units, then the values of θ, in the interval $\left(0,\dfrac{\pi}{2}\right)$, is/are

(a) $\dfrac{\pi}{9}$ (b) $\dfrac{2\pi}{9}$

(c) $\dfrac{\pi}{3}$ (d) $\dfrac{4\pi}{9}$

14. Let $\vec{a}$ and $\vec{b}$ are two given perpendicular vectors, which are non-zero. A vector $\vec{r}$ satisfying the equation $\vec{r}\times\vec{b}=\vec{a}$, can be

(a) $\vec{b}-\dfrac{\vec{a}\times\vec{b}}{|\vec{b}|^2}$ (b) $2\vec{b}-\dfrac{\vec{a}\times\vec{b}}{|\vec{b}|^2}$

(c) $|\vec{a}|\vec{b}-\dfrac{\vec{a}\times\vec{b}}{|\vec{b}|^2}$ (d) $|\vec{b}|\vec{b}-\dfrac{\vec{a}\times\vec{b}}{|\vec{b}|^2}$

15. If $\vec{a},\vec{b},\vec{c}$ are three non-zero vectors, then which of the following statement(s) is/are true?

(a) $\vec{a}\times(\vec{b}\times\vec{c}),\vec{b}\times(\vec{c}\times\vec{a}),\vec{c}\times(\vec{a}\times\vec{b})$ form a right handed system

(b) $\vec{c},(\vec{a}\times\vec{b})\times\vec{c},\vec{a}\times\vec{b}$ form a right handed system

(c) $\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}<0$ if $\vec{a}+\vec{b}+\vec{c}=\vec{0}$

(d) $\dfrac{(\vec{a}\times\vec{b})\cdot(\vec{b}\times\vec{c})}{(\vec{b}\times\vec{c})\cdot(\vec{a}\times\vec{c})}=-1$ if $\vec{a}+\vec{b}+\vec{c}=\vec{0}$

16. Vectors $\vec{a},\vec{b},\vec{c}$ are three unit vectors and $\vec{c}$ is equally inclined to both $\vec{a}$ and $\vec{b}$. Let

$$\vec{a}\times(\vec{b}\times\vec{c})+\vec{b}\times(\vec{c}\times\vec{a})=(4+x^2)\vec{b}-(4x\cos^2\theta)\vec{a},$$

then ($\vec{a}$ and $\vec{b}$ are non-collinear vectors, $x>0$)

(a) $x=2$ (b) $\theta=0^\circ$

(c) $\theta=\pi$ (d) $x=4$

17. If $\vec{a}$ and $\vec{b}$ are unequal unit vectors such that $(\vec{a}-\vec{b})\times[(\vec{b}+\vec{a})\times(2\vec{a}+\vec{b})]=\vec{a}+\vec{b}$, then angle θ between $\vec{a}$ and $\vec{b}$ can be

(a) $\dfrac{\pi}{2}$ (b) 0 (c) π (d) $\dfrac{\pi}{4}$

Comprehension Type

For Q. 18 to 20

$\vec{a}=2\hat{i}+\hat{j}+2\hat{k}$, $\vec{b}=\hat{i}-\hat{j}+\hat{k}$ and non zero vector $\vec{c}$ are such that $(\vec{a}\times\vec{b})\times\vec{c}=\vec{a}\times(\vec{b}\times\vec{c})$

18. Then vector $\vec{c}$ may be given as

(a) $4\hat{i}+2\hat{j}+4\hat{k}$ (b) $4\hat{i}-2\hat{j}+4\hat{k}$

(c) $\hat{i}+\hat{j}+\hat{k}$ (d) $\hat{i}-4\hat{j}+\hat{k}$

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19. Volume of parallelepiped whose adjacent sides are given by $\vec{a}, \vec{b}, \vec{b} \times \vec{c}$ is (use $\vec{c}$ of Q. no. 18)
(a) 18 (b) 54 (c) 12 (d) 36

20. A vector along the bisector of angle between the vectors $\vec{b}$ and $\vec{c}$ (use $\vec{c}$ of Q. no. 18) is

(a) $(2+\sqrt{3})\hat{i}+(1-\sqrt{3})\hat{j}+(2+\sqrt{3})\hat{k}$
(c) $(2-\sqrt{3})\hat{i}+((\sqrt{3}+1)\hat{j}+(2-\sqrt{3})\hat{k})$
(b) $(2+\sqrt{3})\hat{i}+(1-\sqrt{3})\hat{j}-(2+\sqrt{3})\hat{k}$
(d) $(2+\sqrt{3})\hat{i}-(1-\sqrt{3})\hat{j}+(2+\sqrt{3})\hat{k}$

Answers Key

Single Correct Answer Type

1. (b)	**2.** (c)	**3.** (d)	**4.** (b)
5. (c)	**6.** (c)	**7.** (a)	**8.** (a)
9. (b)	**10.** (b)	**11.** (a)	**12.** (b)

Multiple Correct Answers Type

13. (a, b, d) **14.** (a, b, c, d)
15. (b, c, d) **16.** (a, b, c)
17. (a, c)

Comprehension Type

18. (a) **19.** (d) **20.** (a)

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CHAPTER

3

Three-Dimensional Geometry

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DPP 3.1

3D Coordinate System

Single Correct Answer Type

1. Given two points A and B. If area of triangle ABC is constant then locus of point C in space is
   (a) sphere (b) cone
   (c) cylinder (d) none of these

2. The direction cosines of a line equally inclined to three mutually perpendicular lines having direction cosines as l_1, m_1, n_1; l_2, m_2, n_2 and l_3, m_3, n_3 are
   (a) $l_1 + l_2 + l_3, m_1 + m_2 + m_3, n_1 + n_2 + n_3$
   (b) $\frac{l_1 + l_2 + l_3}{\sqrt{3}}, \frac{m_1 + m_2 + m_3}{\sqrt{3}}, \frac{n_1 + n_2 + n_3}{\sqrt{3}}$
   (c) $\frac{l_1 + l_2 + l_3}{3}, \frac{m_1 + m_2 + m_3}{3}, \frac{n_1 + n_2 + n_3}{3}$
   (d) none of these

3. If $P(x, y, z)$ is a point on the line segment joining $Q(2, 2, 4)$ and $R(3, 5, 6)$ such that the projections of $\vec{OP}$ on the axes are $\frac{13}{5}, \frac{19}{5}, \frac{26}{5}$ respectively, then P divides QR in the ratio:
   (a) 1 : 2 (b) 3 : 2 (c) 2 : 3 (d) 1 : 3

4. $A = \begin{bmatrix} l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \\ l_3 & m_3 & n_3 \end{bmatrix}$ and $B = \begin{bmatrix} p_1 & q_1 & r_1 \\ p_2 & q_2 & r_2 \\ p_3 & q_3 & r_3 \end{bmatrix}$

   where p_i, q_i, r_i are the co-factors of the elements l_i, m_i, n_i for $i = 1, 2, 3$. If (l_1, m_1, n_1), (l_2, m_2, n_2) and (l_3, m_3, n_3) are the direction cosines of three mutually perpendicular lines then (p_1, q_1, r_1), (p_2, q_2, r_2) and (p_3, q_3, r_3) are
   (a) the direction cosines of three mutually perpendicular lines
   (b) the direction ratios of three mutually perpendicular lines which are not direction cosines

(c) the direction cosines of three lines which need not be perpendicular
(d) the direction ratios but not the direction cosines of three lines which need not be perpendicular

5. A line segment joining (1, 0, 1) and the origin (0, 0, 0) is revolved about the x-axis to form a right circular cone. If (x, y, z) is any point on the cone, other than the origin, then it satisfies the equation
(a) $x^2 - 2y^2 - z^2 = 0$
(b) $x^2 - y^2 - z^2 = 0$
(c) $2x^2 - y^2 - 2z^2 = 0$
(d) $x^2 - 2y^2 - 2z^2 = 0$

6. Three straight lines mutually perpendicular to each other meet in a point P and one of them intersects the x-axis and another intersects the y-axis, while the third line passes through a fixed point $(0, 0, c)$ on the z-axis. Then the locus of P is
(a) $x^2 + y^2 + z^2 - 2cx = 0$
(b) $x^2 + y^2 + z^2 - 2cy = 0$
(c) $x^2 + y^2 + z^2 - 2cz = 0$
(d) $x^2 + y^2 + z^2 - 2c(x + y + z) = 0$

7. $ABCD$ is a tetrahedron such that each of ΔABC, ΔABD and ΔACD has a right angle at A. If $\text{ar}(\Delta ABC) = k_1$, $\text{ar}(\Delta ABD) = k_2$, $\text{ar}(\Delta ACD) = k_3$ then $\text{ar}(\Delta ACD)$ is

(a) $\sqrt{k_1^2 + k_2^2 + k_3^2}$ (b) $\sqrt{\dfrac{k_1k_2k_3}{k_1 + k_2 + k_3}}$

(c) $\sqrt{|k_1^2 + k_2^2 - k_3^2|}$ (d) $\sqrt{|k_2^2 - k_1^2 - k_3^2|}$

8. The angle between the line whose d.c.'s are connected by the relations $l^2 + m^2 - n^2 = 0$ and $l + m + n = 0$ is
(a) $\pi/6$ (b) $\pi/4$
(c) $\pi/3$ (d) $\pi/2$

Multiple Correct Answers Type

9. The volume of a right triangular prism $ABCA_1B_1C_1$ is equal to 3 cubic unit. Then the co-ordinates of the vertex A_1, if the co-ordinates of the base vertices of the prism are $A(1, 0, 1)$, $B(2, 0, 0)$ and $C(0, 1, 0)$, are
(a) $(-2, 0, 2)$ (b) $(0, -2, 0)$
(c) $(0, 2, 0)$ (d) $(2, 2, 2)$

10. A and B are two points with coordinates (x_1, y_1, z_1) and (x_2, y_2, z_2), respectively, in space. Let P and Q be feet of the perpendiculars drawn from A and B to a line L whose direction ratios are l, m, n. Let θ be the angle between AB and L then
(a) $PQ = AB\cos\theta$
(b) $PQ = |(x_2 - x_1)l + (y_2 - y_1)m + (z_2 - z_1)n|$
(c) $PQ = \dfrac{|(x_2 - x_1)l + (y_2 - y_1)m + (z_2 - z_1)n|}{\sqrt{l^2 + m^2 + n^2}}$
(d) AB and PQ are always coplanar

11. The direction cosines of two lines are connected by relations $l + m + n = 0$ and $4l$ is the harmonic mean between m and n.
Then,
(a) $\dfrac{l_1}{l_2} + \dfrac{m_1}{m_2} + \dfrac{n_1}{n_2} = -3/2$
(b) $l_1l_2 + m_1m_2 + n_1n_2 = -1/2$
(c) $l_1m_1n_1 + l_2m_2n_2 = -\sqrt{6}/9$
(d) $(l_1 + l_2)(m_1 + m_2)(n_1 + n_2) = \dfrac{\sqrt{6}}{18}$

Answers Key

Single Correct Answer Type

1. (c) **2.** (b) **3.** (b) **4.** (a)
5. (b) **6.** (c) **7.** (c) **8.** (c)

Multiple Correct Answers Type

9. (b, d) **10.** (a, c)
10. (a, c) **11.** (a, b, c, d)

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DPP 3.2

Equation of Straight Line and its Applications

Single Correct Answer Type

1. The ratio in which the plane $2x - 1 = 0$ divides the line joining $(-2, 4, 7)$ and $(3, -5, -8)$ is
   (a) 2:3 (b) 4:5 (c) 7:8 (d) 1:1

2. If the lines
   $(\vec{r} - (\hat{i} + \hat{j} + \hat{k})) \times ((1-p)\hat{i} + 3\hat{j} - 2\hat{k}) = 0$
   and
   $(\vec{r} - (3\hat{i} + \hat{j} - 5\hat{k})) \times ((3-p)\hat{i} + 4\hat{j} - 8\hat{k}) = 0$
   are coplanar then the value of p is
   (a) $\frac{4}{3}$ (b) 1 (c) $\frac{2}{3}$ (d) $\frac{1}{3}$

3. A ray of light is sent through the point $P(1, 2, 3)$ and is reflected on the XY plane. If the reflected ray passes through the point $Q(3, 2, 5)$ then the equation of the reflected ray is
   (a) $\frac{x-3}{1} = \frac{y-2}{0} = \frac{z-5}{1}$
   (b) $\frac{x-3}{1} = \frac{y-2}{0} = \frac{z-5}{-4}$
   (c) $\frac{x-3}{1} = \frac{y-2}{0} = \frac{z-5}{4}$
   (d) $\frac{x-1}{1} = \frac{y-2}{0} = \frac{z-3}{4}$

4. If the lines $x = y = z$ and $x = \frac{y}{2} = \frac{z}{3}$ and a line passing through $(1, 1, 1)$ forms a triangle of area $\sqrt{6}$ sq. unit then point of intersection of third line with second line will be
   (a) $\left(\frac{4}{3}, \frac{8}{3}, \frac{12}{3}\right)$ (b) $(1, 2, 3)$
   (c) $(2, 4, 6)$ (d) $(3, 6, 9)$

5. A line with direction ratios $(2, 1, 2)$ intersects the lines $\vec{r} = -\hat{j} + \lambda(\hat{i} + \hat{j} + \hat{k})$ and $\vec{r} = -\hat{i} + \mu(2\hat{i} + \hat{j} + \hat{k})$ at A and B, respectively, then length of AB is equal to
   (a) 1 (b) 2 (c) 3 (d) 4

6. The centroid of the triangle formed by $(0, 0, 0)$ and the point of intersection of $\frac{x-1}{1} = \frac{y-1}{2} = \frac{z-1}{1}$ with $x = 0$ and $y = 0$ is
   (a) $(1, 1, 1)$ (b) $(1/6, -1/3, 1/6)$
   (c) $(-1/6, 1/3, -1/6)$ (d) $(1/3, 1/3, 1/3)$

7. The distance of the point $-\hat{i} + 2\hat{j} + 6\hat{k}$ from the straight line through the point $(2, 3, -4)$ and parallel to $6\hat{i} + 3\hat{j} - 4\hat{k}$ is
   (a) 6 (b) 7 (c) 8 (d) 9

8. If the line $\frac{x-2}{-1} = \frac{y+2}{1} = \frac{z+k}{4}$ is one of the angle bisectors of the lines $\frac{x}{1} = \frac{y}{-2} = \frac{z}{3}$ and $\frac{x}{-2} = \frac{y}{3} = \frac{z}{1}$ then the value of k is
   (a) 1 (b) 2 (c) 4 (d) 8

9. A variable point P is on the circle $x^2 + y^2 = 1$ on xy plane. From point P, perpendicular PN is drawn to the line $x = y = z$ then the minimum length of PN is
   (a) $\sqrt{2}$ (b) $\frac{1}{\sqrt{2}}$
   (c) $\sqrt{3}$ (d) $\frac{1}{\sqrt{3}}$

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Multiple Correct Answers Type

10. Which of the following is/are the point/points that is/are at a distance of 12 units from the point whose position vector is $(8\hat{i}+10\hat{j}-8\hat{k})$ on the line which is parallel to $(2\hat{i}+\hat{j}+2\hat{k})$?

(a) $16\hat{i}+14\hat{j}$ (b) $6\hat{j}-16\hat{k}$

(c) $(16\hat{i}+18\hat{j}-4\hat{k})$ (d) none of these

11. Three mutually perpendicular lines are drawn from the point (1, 2, –1). If one of the lines is perpendicular to the x-axis and the direction ratios of the second line are (1, 2, –1), then which of the following is/are possibly the equation(s) of the third line

(a) $\vec{r}=6\hat{i}+\lambda(5\hat{i}-2\hat{j}+\hat{k})$

(b) $\dfrac{x-1}{5}=\dfrac{y-3}{-2}=\dfrac{z+1}{1}$

(c) $\dfrac{x+4}{5}=\dfrac{y-4}{-2}=\dfrac{z+2}{1}$

(d) none of these

12. The lines $\dfrac{x-1}{1}=\dfrac{y+1}{-1}=\dfrac{z}{2}$ and

$\dfrac{x}{2}=\dfrac{y-1}{-2}=\dfrac{z-1}{\lambda}$ are

(a) parallel if $\lambda=4$

(b) perpendicular if $\lambda=-1$

(c) coplanar if $\lambda=4$

(d) skew lines if $\lambda=5$

Matching Column Type

13. Match the following lists:

List I		List II	
(p)	$\dfrac{x-1}{2}=\dfrac{y-2}{3}=\dfrac{z-3}{4}$ and $\dfrac{x-1}{3}=\dfrac{y-3}{4}=\dfrac{z-5}{5}$ are	(1)	Coincident lines
(q)	$\dfrac{x-1}{2}=\dfrac{y-2}{3}=\dfrac{z-3}{4}$ and $\dfrac{x-3}{2}=\dfrac{y-5}{3}=\dfrac{z-7}{4}$ are	(2)	Parallel lines
(r)	$\dfrac{x-2}{5}=\dfrac{y+3}{4}=\dfrac{5-z}{2}$ and $\dfrac{x-7}{5}=\dfrac{y-1}{4}=\dfrac{z-2}{-2}$ are	(3)	Skew lines
(s)	$\dfrac{x-3}{2}=\dfrac{y+2}{3}=\dfrac{z-4}{5}$ and $\dfrac{x-3}{3}=\dfrac{y-2}{2}=\dfrac{z-7}{5}$ are	(4)	Intersecting at a point

Codes

	(p)	(q)	(r)	(s)
(a)	(3)	(1)	(2)	(4)
(b)	(2)	(3)	(4)	(1)
(c)	(4)	(1)	(2)	(3)
(d)	(2)	(4)	(3)	(1)

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Answers Key

Single Correct Answer Type

1. (d) **2.** (d) **3.** (c) **4.** (c)
5. (c) **6.** (b) **7.** (b) **8.** (d)
9. (d)

Multiple Correct Answers Type

10. (a, b) **11.** (a, c)
12. (a, b, c, d)

Matching Column Type

13. (c)

DPP 3.3

Equation of Plane and its Applications - I

Single Correct Answer Type

1. Equation of the plane passing through the origin and perpendicular to the planes $x + 2y + z = 1$, $3x - 4y + z = 5$ is
   (a) $x + 2y - 5z = 0$ (b) $x - 2y - 3z = 0$
   (c) $x - 2y + 5z = 0$ (d) $3x + y - 5z = 0$
2. A vector $\vec{n}$ is inclined to x-axis at 45°, to y-axis at 60° and at an acute angle to z-axis. If $\vec{n}$ is a normal to a plane passing through the point $(\sqrt{2}, -1, 1)$, then the equation of plane is
   (a) $3\sqrt{2}x - 4y - 3z = 7$
   (b) $4\sqrt{2}x + 7y + z = 2$
   (c) $\sqrt{2}x + y + z = 2$
   (d) $\sqrt{2}x - y - z = 2$
3. If the perpendicular distance of a point P other than the origin from the plane $x + y + z = p$ is equal to the distance of the plane from the origin, then the coordinates of P are
   (a) $(p, 2p, 0)$ (b) $(0, 2p, -p)$
   (c) $(2p, p, -p)$ (d) $(2p, -p, 2p)$
4. The distance of the point $(-1, -5, -10)$ from the point of intersection of the line $\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-2}{12}$ and plane $x - y + z = 5$ is
   (a) 10 (b) 8 (c) 21 (d) 13
5. Sum of the values of k for which planes $kx + 4y + z = 0$, $4x + ky + 2z = 0$ and $2x + 2y + z = 0$ intersect in a straight line is
   (a) 2 (b) 4 (c) 6 (d) 8
6. Let $P \equiv (1, 7, \sqrt{2})$ be a point and line L is $2\sqrt{2}(x-1) = y - 2, z = 0$. If PQ is the distance of plane $\sqrt{2}x + y - z = 1$ from point P measured along a line inclined at an angle of 45° with the line L and is minimum, then the value of PQ is
   (a) 3 (b) 4 (c) 6 (d) 8
7. Angle between the two planes of which one plane is $4x + y + 2z = 0$ and another plane containing the lines $\frac{x-3}{2} = \frac{y-2}{3} = \frac{z-1}{\lambda}$, $\frac{x-2}{3} = \frac{y-3}{2} = \frac{z-2}{3}$ is
   (a) $\frac{\pi}{3}$ (b) $\frac{\pi}{2}$
   (c) $\frac{\pi}{6}$ (d) $\frac{2\pi}{3}$
8. The distance of the point (1, –2, 3) from the plane $x - y + z - 5 = 0$, measured parallel to the line $\frac{x}{2} = \frac{y}{3} = \frac{z-1}{-6}$ is equal to
   (a) 1 unit (b) 2 units
   (c) 3 units (d) none of these
9. The angle between the pair of planes represented by equation $2x^2 - 2y^2 + 4z^2 + 6xz + 2yz + 3xy = 0$ is
   (a) $\cos^{-1}\left(\frac{1}{3}\right)$ (b) $\cos^{-1}\left(\frac{4}{21}\right)$
   (c) $\cos^{-1}\left(\frac{4}{9}\right)$ (d) $\cos^{-1}\left(\frac{7}{\sqrt{84}}\right)$
10. The Cartesian equation of the plane $\vec{r} = (1 + \lambda - \mu)\hat{i} + (2 - \lambda)\hat{j} + (3 - 2\lambda + 2\mu)\hat{k}$ is
    (a) $2x + y = 5$ (b) $2x - y = 5$
    (c) $2x + z = 5$ (d) $2x - z = 5$

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11. The locus represented by $xy + yz = 0$ is a pair of
(a) perpendicular lines
(b) parallel lines
(c) parallel planes
(d) perpendicular planes

12. Equation of line passing through $A(1, 0, 3)$, intersecting the line $\frac{x}{2} = \frac{y-1}{3} = \frac{z-2}{1}$ and parallel to the plane $x + y + z = 2$ is
(a) $\frac{3x-1}{2} = \frac{2y-3}{3} = \frac{2z-5}{-1}$
(b) $\frac{x-1}{2} = \frac{y-0}{3} = \frac{z-3}{-1}$
(c) $\frac{x-(2/3)}{1} = \frac{y-(3/2)}{0} = \frac{z+(1/2)}{3}$
(d) $\frac{3x-1}{2} = \frac{2y-3}{-3} = \frac{6z-13}{5}$

13. If $P(\alpha, \beta, \gamma)$ is a vertex of an equilateral triangle PQR where vertex Q and R are $(-1, 0, 1)$ and $(1, 0, -1)$, respectively, then P can lie on the plane
(a) $x + y + z + 6 = 0$
(b) $2x + 4y + 3z + 20 = 0$
(c) $x - y + z + 12 = 0$
(d) $x + y + z + 3\sqrt{2} = 0$

14. The variable plane $(2\lambda + 1)x + (3 - \lambda)y + z = 4$ always passes through the line
(a) $\frac{x}{0} = \frac{y}{0} = \frac{z-4}{1}$ (b) $\frac{x}{1} = \frac{y}{2} = \frac{z-4}{-3}$
(c) $\frac{x}{1} = \frac{y}{1} = \frac{z-4}{-7}$ (d) $\frac{x}{1} = \frac{y}{2} = \frac{z-4}{-7}$

Multiple Correct Answers Type

15. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}, \vec{b} = -\hat{i} + \hat{j} + \hat{k}, \vec{c} = \hat{i} - \hat{j} + \hat{k}$ and $\vec{d} = \hat{i} + \hat{j} - \hat{k}$. Then, the line of intersection of planes one determined by $\vec{a}, \vec{b}$ and other determined by $\vec{c}, \vec{d}$ is perpendicular to
(a) x-axis (b) y-axis
(c) z-axis (d) none of these

16. Consider the equations
E_1: $\vec{r} \times (2\hat{i} - \hat{j} + 3\hat{k}) = 3\hat{i} + \hat{k}$ and
E_2: $\vec{r} \times (\hat{i} + 2\hat{j} - 3\hat{k}) = 2\hat{i} - \hat{j}$, then
(a) E_1 represents a line
(b) E_1 represents two parallel planes
(c) E_2 represents a line
(d) E_2 represents two parallel planes

17. The equation of a plane is $2x - y - 3z = 5$ and $A(1, 1, 1)$, $B(2, 1, -3)$, $C(1, -2, -2)$ and $D(-3, 1, 2)$ are four points. Which of the following line segments are intersected by the plane?
(a) AD (b) AB (c) AC (d) BC

Comprehension Type

For Q. 18 and 19

Let P denote the plane consisting of all points that are equidistant from the points $A(-4, 2, 1)$ and $B(2, -4, 3)$ and Q be the plane, $x - y + cz = 1$ where $c \in R$.

18. The plane P is parallel to plane Q
(a) for no value of c (b) if $c = 3$
(c) if $c = 1/3$ (d) if $c = 1$

19. If the angle between the planes P and Q is $45°$ then the product of all possible values of c is
(a) -17 (b) -2
(c) 17 (d) 24/27

For Q. 20–22

A line L_1 with direction ratios $-3, 2, 4$ passes through the point $A(7, 6, 2)$ and a line L_2 with direction ratios $2, 1, 3$ passes through the point $B(5, 3, 4)$. A line L_3 with direction ratios $2, -2, -1$ intersects L_1 and L_3 at C and D, respectively.

20. The length CD is equal to
(a) 4 (b) 6 (c) 9 (d) 11

21. The equation of the plane parallel to line L_1 and containing line L_2 is equal to
(a) $x + 3y + 4z = 30$ (b) $x + 2y + z = 15$
(c) $2x - y + z = 11$ (d) $2x + 17y - 7z = 33$

22. The volume of parallelepiped formed by $\overrightarrow{AB}, \overrightarrow{AC}$ and $\overrightarrow{AD}$ is equal to
(a) 140 (b) 138
(c) 134 (d) 130

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Answers Key

Single Correct Answer Type

1. (d)	**2.** (c)	**3.** (c)	**4.** (d)
5. (c)	**6.** (a)	**7.** (b)	**8.** (a)
9. (c)	**10.** (c)	**11.** (d)	**12.** (d)
13. (d)	**14.** (d)		

Multiple Correct Answers Type

15. (b, c) **16.** (b, c)
17. (b, c)

Comprehension Type

18. (c) **19.** (b) **20.** (c) **21.** (d)
22. (b)

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DPP 3.4

Equation of Plane and its Applications - II

Single Correct Answer Type

1. Let $A(0, 6, 6)$, $B(6, 6, 0)$ and $C(6, 0, 6)$ are three points and point D is moving on the line $x+z-3=0=y$. If G is centroid of ΔABC, then minimum value of GD is

(a) $\sqrt{\frac{47}{2}}$ (b) $\sqrt{\frac{37}{2}}$

(c) $\sqrt{\frac{57}{2}}$ (d) $\sqrt{\frac{23}{2}}$

2. Equation of line of projection of the line $3x-y+2z-1=0=x+2y-z-2$ on the plane $3x+2y+z=0$ is

(a) $\frac{x+1}{11}=\frac{y-1}{-9}=\frac{z-1}{-15}$

(b) $3x-8y+7z+4=0=3x+2y+z$

(c) $\frac{x+12}{11}=\frac{y+8}{-9}=\frac{z+14}{15}$

(d) $\frac{x+12}{11}=\frac{y+8}{-9}=\frac{z+14}{-15}$

3. The orthocenter of triangle whose vertices are $A(a, 0, 0)$, $B(0, b, 0)$ and $C(0, 0, c)$ is $\left(\frac{k}{a}, \frac{k}{b}, \frac{k}{c}\right)$ then k is equal to

(a) $\left(\frac{1}{a^2}+\frac{1}{b^2}+\frac{1}{c^2}\right)^{-1}$ (b) $\left(\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right)^{-1}$

(c) $\frac{1}{a^2}+\frac{1}{b^2}+\frac{1}{c^2}$ (d) $\frac{1}{a}+\frac{1}{b}+\frac{1}{c}$

4. The shortest distance between the lines $2x+y+z-1=0=3x+y+2z-2$, and $x=y=z$, is

(a) $\frac{1}{\sqrt{2}}$ units (b) $\sqrt{2}$ units

(c) $\frac{3}{\sqrt{2}}$ units (d) $\frac{\sqrt{3}}{2}$ units

5. If plane $2x+3y+6z+k=0$ is tangent to the sphere $x^2+y^2+z^2+2x-2y+2z-6=0$, then a value of k is

(a) 26 (b) 16

(c) -26 (d) none of these

6. The shortest distance from $(1, 1, 1)$ to the line of intersection of the pair of planes $xy+yz+zx+y^2=0$ is

(a) $\sqrt{\frac{8}{3}}$ (b) $\frac{2}{\sqrt{3}}$

(c) $\frac{1}{\sqrt{3}}$ (d) $\frac{2}{3}$

7. A variable plane makes intercepts on x, y and z axes and it makes a tetrahedron of volume 64 cu. units. The locus of foot of perpendicular from origin on this plane is

(a) $(x^2+y^2+z^2)^3=384xyz$

(b) $xyz=681$

(c) $(x+y+z)\left(\frac{1}{x}+\frac{1}{y}+\frac{1}{z}\right)^2=16$

(d) $xyz(x+y+z)=81$

8. If the projection of the line $\frac{x}{2}=\frac{y-1}{2}=\frac{z-1}{1}$ on a plane P is $\frac{x}{1}=\frac{y-1}{1}=\frac{z-1}{-1}$. Then the distance of plane P from origin is

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(a) $\sqrt{3}$ (b) $\sqrt{\frac{3}{2}}$

(c) $\sqrt{6}$ (d) $\frac{2}{\sqrt{3}}$

9. Image of sphere $x^2 + y^2 + z^2 = 9$ in plane $2x + 3y + 4z - 29 = 0$ is

(a) $x^2 + y^2 + z^2 - 8x - 12y - 16z + 107 = 0$
(b) $x^2 + y^2 + z^2 + 8x - 12y - 16z + 107 = 0$
(c) $x^2 + y^2 + z^2 - 8x + 12y - 16z + 107 = 0$
(d) $x^2 + y^2 + z^2 - 8x - 12y + 16z + 107 = 0$

10. The locus of a point which moves in such a way that its distance from the line $\frac{x}{1} = \frac{y}{1} = \frac{z}{-1}$ is twice the distance from the plane $x + y + z = 0$ is

(a) $x^2 + y^2 + z^2 - 5x - 3y - 3z = 0$
(b) $x^2 + y^2 + z^2 - 5x + 3y + 3z = 0$
(c) $x^2 + y^2 + z^2 + 5xy + 3yz + zx = 0$
(d) $x^2 + y^2 + z^2 + 5xy + 3yz + 3zx = 0$

11. A plane cutting the axes in P, Q, R passes through $(\alpha - \beta, \beta - \gamma, \gamma - \alpha)$. If O is origin, then locus of centre of sphere $OPQR$ is

(a) $\alpha x + \beta y + \gamma z = 4$
(b) $(\alpha - \beta)x + (\beta - \gamma)y + (\gamma - \alpha)z = 0$
(c) $(\alpha - \beta)yz + (\beta - \gamma)zx + (\gamma - \alpha)xy = 2xyz$
(d) $\left(\frac{1}{\alpha^2} + \frac{1}{\beta^2} + \frac{1}{\gamma^2}\right)(x^2 + y^2 + z^2) = xyz$

12. A line is drawn from the point $P(1, 1, 1)$ and perpendicular to a line with direction ratios $(1, 1, 1)$ to intersect the plane $x + 2y + 3z = 4$ at Q. The locus of point Q is

(a) $\frac{x}{1} = \frac{y-5}{-2} = \frac{z+2}{1}$
(b) $\frac{x}{-2} = \frac{y-5}{1} = \frac{z+2}{1}$
(c) $x = y = z$
(d) none of these

Multiple Correct Answers Type

13. Let a plane pass through origin and be parallel to the line $\frac{x-1}{2} = \frac{y+3}{-1} = \frac{z+1}{-2}$ is such that distance between plane and the line is $\frac{5}{3}$. Then equation of the plane is/are

(a) $x - 2y + 2z = 0$ (b) $x - 2y - 2z = 0$
(c) $2x + 2y + z = 0$ (d) $x + y + z = 0$

14. The planes $ax + 4y + z = 0$, $2x + 3z - 1 = 0$ and $3x - bz + 2 = 0$ will

(a) meet at a point if $ab \neq 15$
(b) meet on a line if $ab = 15$, $a = 3$
(c) have no common point if $ab = 15$, $a \neq 3$
(d) have no common point if $ab = 15$, $a \neq 5$

15. If the line $\frac{x}{2} = \frac{y}{2} = \frac{z}{3}$ intersects the line

$\alpha^2 x + 3(1 - 2\alpha)y + z$

$= 3 = -\frac{1}{2}\{6\alpha^2 x + 3(1 - 2\beta)y + 2z\}$

then point $(\alpha, \beta, 1)$ lies on the plane

(a) $2x - y + z = 4$ (b) $x + y - z = 2$
(c) $x - 2y = 0$ (d) $2x - y = 0$

Comprehension Type

For Q. 16 and 17

Let $A = (1, 1, -1)$, $B = (0, 2, 1)$ be two given points. Also, let $P: x + y + z = 0$ be a plane.

16. If A' and B' are the feet of perpendiculars from A and B, respectively, on the plane 'P' then $A'B'$ equals

(a) $\sqrt{\frac{14}{3}}$ (b) $\sqrt{\frac{5}{3}}$

(c) $\sqrt{3}$ (d) $\sqrt{\frac{2}{3}}$

17. The equation of the line perpendicular to $\overline{AB}$ and lying completely in the plane 'P' is

(a) $\frac{x - \frac{3}{2}}{1} = \frac{y - \frac{1}{2}}{-3} = \frac{z+2}{2}$
(b) $\frac{x-3}{2} = \frac{y-1}{-6} = \frac{z+2}{2}$
(c) $x = y = z$
(d) $x - 3 = y - 1 = z + 2$

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For Q. 18 and 19

Let $P_1: x + y + 2z - 3 = 0$ and $P_2: x - 2y + z = 4$ be two planes. Also, let $A(1, 3, 4)$ and $B(3, 2, 7)$ be two points in space.

18. The equation of plane which passes through line of intersection of P_1 and P_2 and upon which length of projection of the line segment AB is the greatest, is

(a) $2x + 3y + z + 4 = 0$ (b) $3x - 3y + 4z - 11 = 0$
(c) $x + 3y + z + 2 = 0$ (d) $3y + z + 1 = 0$

19. The equation of plane which passes through line of intersection of P_1 and P_2 and upon which length of projection of the line segment AB is the least, is

(a) $x + 3y + z + 2 = 0$
(b) $3y + z + 1 = 0$
(c) $2x - y + 3z - 7 = 0$
(d) $3x - 3y + 4z - 11 = 0$

Answers Key

Single Correct Answer Type

1. (c)	**2.** (b)	**3.** (a)	**4.** (a)
5. (a)	**6.** (a)	**7.** (a)	**8.** (b)
9. (a)	**10.** (c)	**11.** (c)	**12.** (a)

Multiple Correct Answers Type

13. **(a, c)** **14.** **(a, b, c)**
15. **(a, b, c)**

Comprehension Type

16. (a) **17.** (a) **18.** (d) **19.** (c)

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